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## PATENT SPECIFICATION



Application Date: Feb. 27, 1939. No. 6454/39.

525.736

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Complete Specification Accepted: Sept. 3, 1940.

### PROVISIONAL SPECIFICATION

#### Improvements in and relating to Apparatus for the Nebulisation of Liquids

We, GEOFFREY WARNER PARR, of 4, Green Pillars, Wrotham Heath, Kent, a British subject, and CHARLES AUSTEN LIMITED, of 18, Essex Street, London, W.C.2, an English Company, do hereby declare the nature of this invention to be as follows:—

This invention relates to an improved device for the nebulisation of liquids by means of compressed air or other gas under pressure, the process of nebulisation being defined as the breaking up of a liquid into droplets so small that a stable cloud is formed in the air, and has for its object the provision of a device that shall be simple and easily cleaned and at the same time efficiently adapted for its designed purpose.

A device constructed according to this invention consists broadly of a simple atomiser of known type, which preferably takes the form of an air-jet directed across the open top of a tube whose lower end dips into the liquid to be nebulised, so disposed that its spray is directed into the mouth of an open blast tube, through which the spray is driven at considerable velocity by the air escaping from the air jet, together with additional air drawn in by the blast. Opposite the other end of the blast tube is a deflector cup into which the mixture of air and liquid is directed, as hereinafter described in detail.

In an embodiment of the invention particularly suitable for air humidification or for the nebulisation of antiseptic liquids in hospitals or the like, the apparatus is arranged vertically with the atomiser at the bottom, and the deflector cup at the top, of the blast tube, and is contained within two superimposed bowls, of which the lower forms a container for the liquid to be nebulised, while the upper is adapted to form a trap for the unnebulised liquid carried upwards by the atomiser spray, and to return it to the lower bowl.

The atomiser is secured through the bottom of the lower bowl and takes the form of an air jet having a bore of 1.3 m.m. directed vertically upwards. Immediately above the jet is disposed the upper end of the liquid tube, 3 m.m. external

diameter and 1.85 m.m. bore, having its mouth inclined at an angle of 60° to, and approximately coincident with, the axis of the air jet its lower end is bent downwards and terminates about 1 m.m. from the bottom of the bowl.

The blast tube has its lower end 7 m.m. above the level of the tip of the air jet, and takes the form of an open truncated cone, 60 m.m. diameter at its lower end, 25 m.m. diameter at its upper end and 100 m.m. high, and is secured through the bottom of the upper bowl. The deflector cup also takes the form of a truncated cone, open at the bottom and closed at the top, the bottom being 60 m.m. diameter and the top 25 m.m. diameter. The depth of the cup is 35 m.m. and its open bottom is 10 m.m. above the upper end of the blast tube.

The upper bowl has one or more drain holes drilled through it and is partly covered by a splash guard which closely fits the rim of the bowl and which has an opening 90 m.m. in diameter in its centre. The opening may conveniently have a bar formed or secured across its diameter, to the centre of which the deflector cup may be secured. The bowls may be of any convenient diameter, but the upper bowl should not be smaller than 150 m.m. diameter for best results.

In operation, the liquid to be nebulised is poured into the lower bowl to a depth of 20 to 30 m.m. and the air jet is connected to a supply of compressed air, or other suitable gas. The resulting blast of air across the open mouth of the liquid tube causes a reduction of pressure therein, in known manner, liquid being drawn upwards through the tube into the jet of air, which atomises it and drives it at considerable velocity through the blast tube, where it mixes with air drawn in by the blast and is then driven into the deflector cup, where it is still further atomised. Part of the liquid is broken up into droplets small enough to form a stable cloud, which behaves as a true vapour and escapes through the opening in the centre of the splash guard, while the remainder is caught by the deflector cup and returned to the lower bowl via the drain holes in

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the upper bowl.

When supplied with air at a pressure of 10 pounds per square inch, a nebuliser made to the dimensions given will nebulise approximately 120 cubic centimetres of water per hour.

The particular embodiment of our invention described in detail is mentioned only as an example and we do not confine ourselves to the specific arrangement or dimensions given. For example, the blast tube may be cylindrical in form, instead of conical, as described, and it may be divided into two or more sections, and

although we usually prefer to employ an atomiser of the simple cross-jet type described, we may use other known or new types, such as the concentric jet type commonly used for paint sprays.

Dated the 27th day of February, 1939.

G. WARNER PARR,

CHARLES AUSTIN LIMITED.  
For and on behalf of Charles Austin Limited,

G. WARNER PARR,

Secretary.

H. E. IRVING FOSTER,  
Director.

## COMPLETE SPECIFICATION

### Improvements in and relating to Apparatus for the Nebulization of Liquids

We, GEOFFREY WARNER PARR, a British Subject, of Four Green Pillars, Wrotham Heath, Kent, and CHARLES AUSTIN LIMITED, a British Company, of 18, Essex Street, London, W.C.2, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

This invention relates to apparatus for nebulisation of liquids, that is to say, the production of a suspension of a liquid in finely divided form in air or other gas.

Various forms of apparatus have been proposed for producing such suspensions. For example, in Specification No. 237,992 there is shown an air conditioning device in which water accompanied by air is sprayed lengthwise of an open-ended tube containing a baffle which is of converging form and has a hole at the centre, and one or more additional flat baffles are provided across the tube beyond this hole. In Specification No. 465,357 there is disclosed another form of such apparatus in which the liquid and air, or other gas, is sprayed on to the walls of the container and the liquid in suspension rises up in a chamber past a plurality of baffles to a discharge opening at the top. In this case, the air or other gas discharged from the casing is only that producing the spray.

It has been proposed in Specification No. 487,704 to provide an apparatus for bringing gas and liquid into intimate contact for various purposes, including the cleaning of gases and the conditioning of air, which apparatus comprises a chamber formed with a venturi-like passage open at both ends for the passage of air or other gas, a jet at one end to which liquid is supplied to feed a cone of spray into the passage and a deflector at the other end formed with the so-called stream-lined inwardly directed protrusion at the centre

for spreading the resultant mixture of gas and liquid radially from the chamber so as to prevent accumulation of liquid which might drop back and interfere with the mixing or wetting action taking place in the chamber.

The invention is concerned with nebulising apparatus for producing a suspension in the form of a so-called persistent cloud of very fine liquid particles, namely, a cloud in which the particles have a greater tendency to disperse laterally than to fall, such for instance as may be required for permeating a room or other large enclosed space. The object of the invention is to provide an apparatus which will produce such a cloud very rapidly and also with a high degree of efficiency in operation. By efficiency in operation is meant the ratio of the quantity of liquid converted into the cloud to the quantity of liquid which is sprayed.

It has been found that if the liquid is sprayed by air or other gas into the open end of a generator tube which is closed at the opposite end, a considerable turbulence occurs within this generator tube which is very favourable to the production of the fine suspension which is required. There is, however, very little possibility for the cloud to be discharged from the generator tube mainly because of condensation on the inner surface of the tube and if it is opened at the far end to permit the discharge of the cloud, then it appears that the turbulence within the generator tube is reduced very considerably with a consequent reduction in the production of the cloud-like suspension.

According to the present invention there is provided an apparatus for producing a cloud-like suspension of a liquid in air or other gas which comprises a generator tube open at both ends, means such as an atomiser for directing a jet of air or other

gas carrying the liquid, in the form of a spray into the tube from a position at or near one end, and a baffle or reflector which is of a size and shape to constitute a closure for the tube but is spaced from the other end of the tube and is of concave shape at the side facing the end of the tube. It is found that by provision of the concave reflector aforesaid, the turbulence within the generator tube is maintained, while providing adequate opening between the reflector and the periphery of the adjacent end of the tube for the outlet of the cloud-like suspension. In particular, it is observed that by this apparatus there is obtained a zone of considerable turbulence approximately midway of the length of the tube, and it is believed that the formation of this turbulent zone accounts for the very efficient operation of the apparatus. A spray of the liquid together with air or other gas is essential for the effective operation of the apparatus because a jet of liquid, if used alone, would unless it were impracticably small, damp out the turbulence in the generator tube.

A further feature of the invention consists in that the interior of the generator tube is in the form of a truncated cone with the smaller end adjacent to the reflector, for the purpose of restricting the passage of the particles of liquid as they come from the atomiser straight through the generator tube.

Another feature of the invention consists in that the interior of the reflector is in the form of a truncated cone with the smaller end closed. It is found to be of advantage to employ a reflector of which the closed end is approximately equal in area to the end of the generator tube to which it is adjacent.

In a form of the apparatus which has been found to be particularly satisfactory in operation, the volume of the interior of the reflector is of the order of one-third of the volume of the interior of the generator tube.

In a preferred construction of the apparatus the generator tube rests on an abutment in the lower part of a working chamber which is open at the bottom and the reflector is carried by a cover for this chamber having an outlet opening for the cloud-like suspension. With this construction the apparatus may be readily dismantled by lifting the cover and with it the reflector and then by lifting the generator tube out of the chamber. The working chamber is conveniently suspended in an outer chamber for the liquid and having the atomiser mounted in the bottom of this outer chamber. Therefore, by lifting the working chamber the in-

terior of the outer chamber and the atomiser are readily accessible.

A further feature of the apparatus consists in the provision of means directing secondary air or other gas into the outer chamber so as to pass through the generator tube with the atomised liquid from the atomiser and furthermore, means may be employed for directing a current of air or other gas adjacent to the outlet opening of the working chamber to assist dispersion of the cloud-like suspension.

In a convenient form of the apparatus it is constructed as a unit with a pump for supplying air to the atomiser, an electric motor driving the pump and a fan also driven by the motor for supplying the secondary air to the generator tube and the current of air adjacent the outlet opening.

One specific construction of the nebulizing apparatus according to the invention is illustrated by way of example in the accompanying drawing showing the apparatus in sectional elevation.

Referring to the drawing, the apparatus is enclosed in a casing 10 having a top 11 provided with a removable cover 12. An outer liquid container 13 for the liquid to be used rests on a base 14 in the casing 10. This outer liquid container 13 which is of cylindrical form has a central boss 15 having an air passage 16 and provided at the top with an atomiser comprising a jet 17 communicating with the air passage and pipes 18 carried by the jet extending at one end into the liquid and at the other end to a position immediately above the orifice of the jet 17. A nozzle 19 communicating with the air passage 16 and extending below the bottom of the container is arranged to engage in a sealing washer 20 in a socket 21 to which air under pressure is applied. A cover plate 22 engages the top of the container with an interposed packing 23, this cover plate forming part of the top 11 of the casing. The arrangement is such that on removal of the cover plate 22 the container 13 may be lifted clear of the casing and be replaced in position with the nozzle 19 engaging in the sealing washer 20 to make the necessary joint.

The plate 22 has a central circular opening in which an inner cylindrical chamber 24 is mounted so as to rest on the plate 22 by means of a shoulder 25 on the exterior of this chamber. This inner chamber 24 is open at both ends and is provided at the bottom with an internal rim 26. A generator tube 27 of frusto-conical form has a flange 28 at its larger end by means of which it rests on the rim 26 and above the atomiser.

Above the generator tube 27 there is

mounted a concave reflector 29 of truncated conical form and this reflector is carried on a spider 30 bridging an outlet opening 31 in a cover 32 which rests on the top of the chamber 26.

In use of the apparatus air under pressure is supplied to the atomiser to produce a spray of small particles of the liquid carried by the air and directed into the generator tube 27. Owing to the provision of the reflector 29 producing in effect a cushioning of air, this tube 27 acts very much as a closed chamber and causes a considerable turbulence to occur in the tube 27 serving to break up the spray into a very fine cloud-like suspension of the liquid. It has been noted that this turbulence takes place in a rather well defined region approximately midway of the length of the generator tube. This suspension in the form of a persistent cloud passes out from the upper end of the generator tube 27 around the lower edge of the reflector 29 and out through the outlet opening 31. Should any of the liquid condense at the outer side of the generator tube 27 it is permitted to drain back into the outer container through a hole 33.

In a construction which has been found to give very satisfactory results the generator tube 27 has a length of about four inches. The diameter of the top of the tube is preferably of the order of one inch and it is found that if made larger the turbulence within the tube is appreciably decreased and there is a tendency for the spray to be driven straight through the generator tube. The diameter of the bottom of the generator tube may be varied, for instance, between two and three inches in this construction. It is preferable for the closed upper end of the reflector to be approximately the same area as the top end of the generator tube and although the angle formed by the wall of this conical reflector may be varied it is found that for best results the volume of the interior of this reflector should be equal to one-third of that of the generator tube. The diameter of the bottom of the reflector may conveniently be the same as that of the bottom of the generator tube. The atomiser is conveniently of the simple cross-jet type as shown in the drawing, but any other atomiser capable of producing a moderately fine spray may be employed.

The air supply to the atomiser is taken from a pump 34 through a receiver 35, the pump being driven by an electric motor 36. On the motor shaft there is provided a radial type fan 37 opposite an opening 38 in the side of the casing 10. This fan delivers a current of air from a housing

39 for the fan through an aperture 40 in the outer container 13 so as to provide secondary air which passes through the generator tube to assist in the production of the cloud-like suspension. Some of the air delivered by the fan passes through an opening 41 in the top 11 of the casing and is directed by a cowl 42 in the direction across the discharge opening 31 for the cloud-like suspension in order to assist in its dispersion. By means of this apparatus there is produced a so-called persistent cloud-like suspension of a liquid with high efficiency as determined by a comparison between the amount of liquid sprayed by the atomiser and the amount of liquid converted into the persistent cloud-like suspension. Moreover, in the construction of the apparatus shown in the drawing the various parts of the apparatus which serve to contain the liquid or suspension are readily removable for cleansing purposes simply by lifting them from their respective mountings.

Having now particularly described and ascertained the nature of our said invention and in what manner the same is to be performed, we declare that what we claim is:—

1. Apparatus for producing a cloud-like suspension of a liquid in air or other gas, which comprises a generator tube open at both ends, means such as an atomiser for directing a jet of air or other gas carrying the liquid in the form of a spray into the tube from a position at or near one end of a baffle or reflector which is of a size and shape to constitute a closure for the other end of the tube but is spaced away therefrom and is of concave shape at the side facing the end of the tube.

2. Apparatus as claimed in claim 1, wherein the interior of the generator tube is in the form of a truncated cone with the smaller end adjacent to the reflector.

3. Apparatus as claimed in claim 1 or claim 2, wherein the interior of the reflector is in the form of a truncated cone with the smaller end closed.

4. Apparatus as claimed in any of the preceding claims wherein the area of the closed end of the reflector is approximately equal to the area of the end of the generator tube to which it is adjacent.

5. Apparatus as claimed in claim 4, wherein the volume of the interior of the reflector is of the order of one-third of the volume of the interior of the generator tube.

6. Apparatus as claimed in any of the preceding claims, wherein the generator tube rests on an abutment in the lower part of a working chamber which is open at the bottom and the reflector is carried

by a cover for this chamber having an outlet opening for the cloud-like suspension.

7. Apparatus as claimed in claim 6, 5 wherein the working chamber is suspended in an outer chamber for the liquid and having the atomiser mounted in the bottom of this outer chamber.

8. Apparatus as claimed in claim 7, 10 comprising means for directing secondary air or other gas into the outer chamber so as to pass through the generator tube with the atomised liquid from the atomiser.

9. Apparatus as claimed in claim 6, 15 claim 7 or claim 8, comprising means for directing a current of air or other gas adjacent to the outlet opening of the working chamber to assist dispersion of

the cloud-like suspension.

10. Apparatus as claimed in any of the 20 preceding claims 6 to 9, constructed as a unit with a pump for supplying air to the atomiser, an electric motor driving the pump and a fan also driven by the motor for supplying the secondary air to the 25 generator tube and the current of air adjacent the outlet opening.

11. Apparatus for producing a cloud-like suspension of a liquid in air or other gas, substantially as herein described with 30 reference to the accompanying drawing.

Dated this 23rd day of February, 1940.

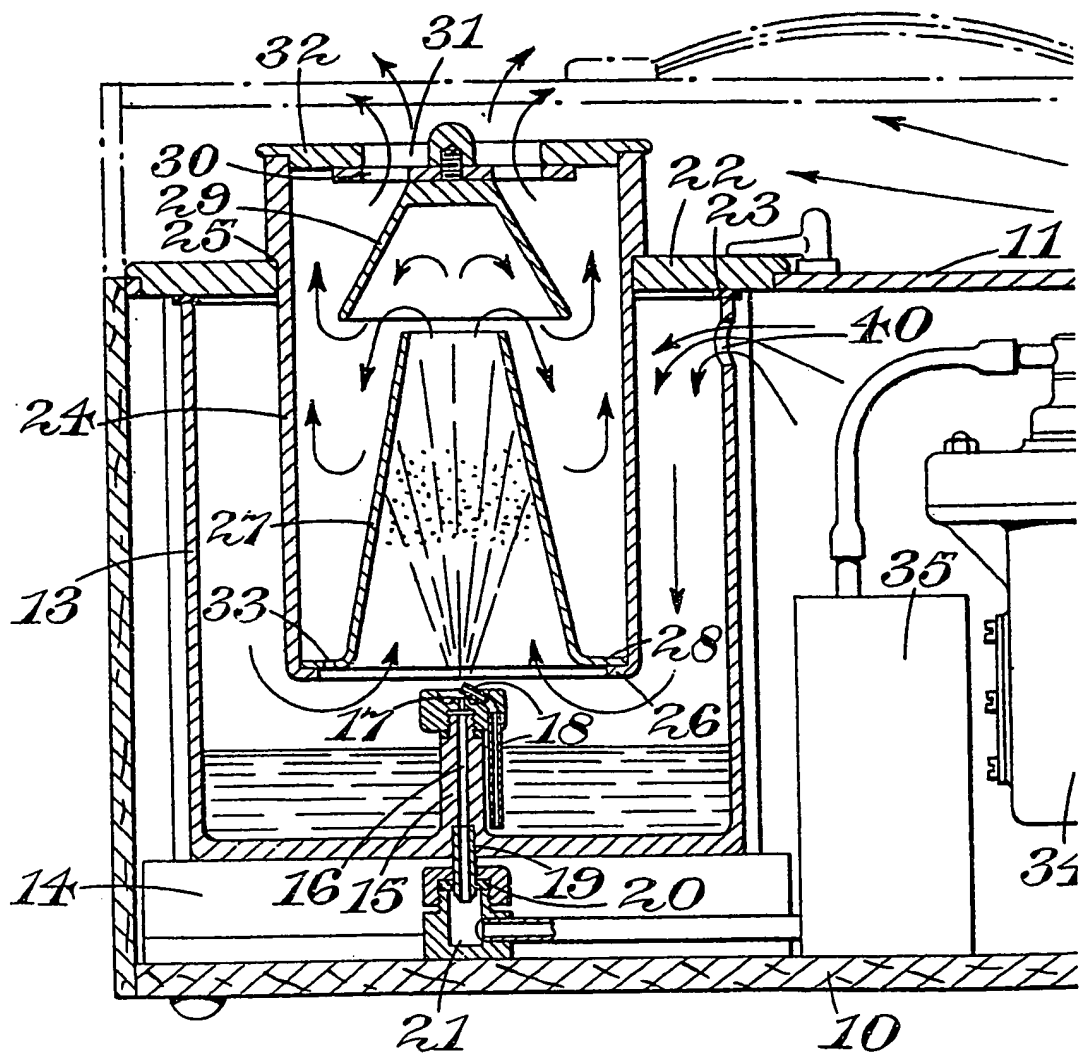
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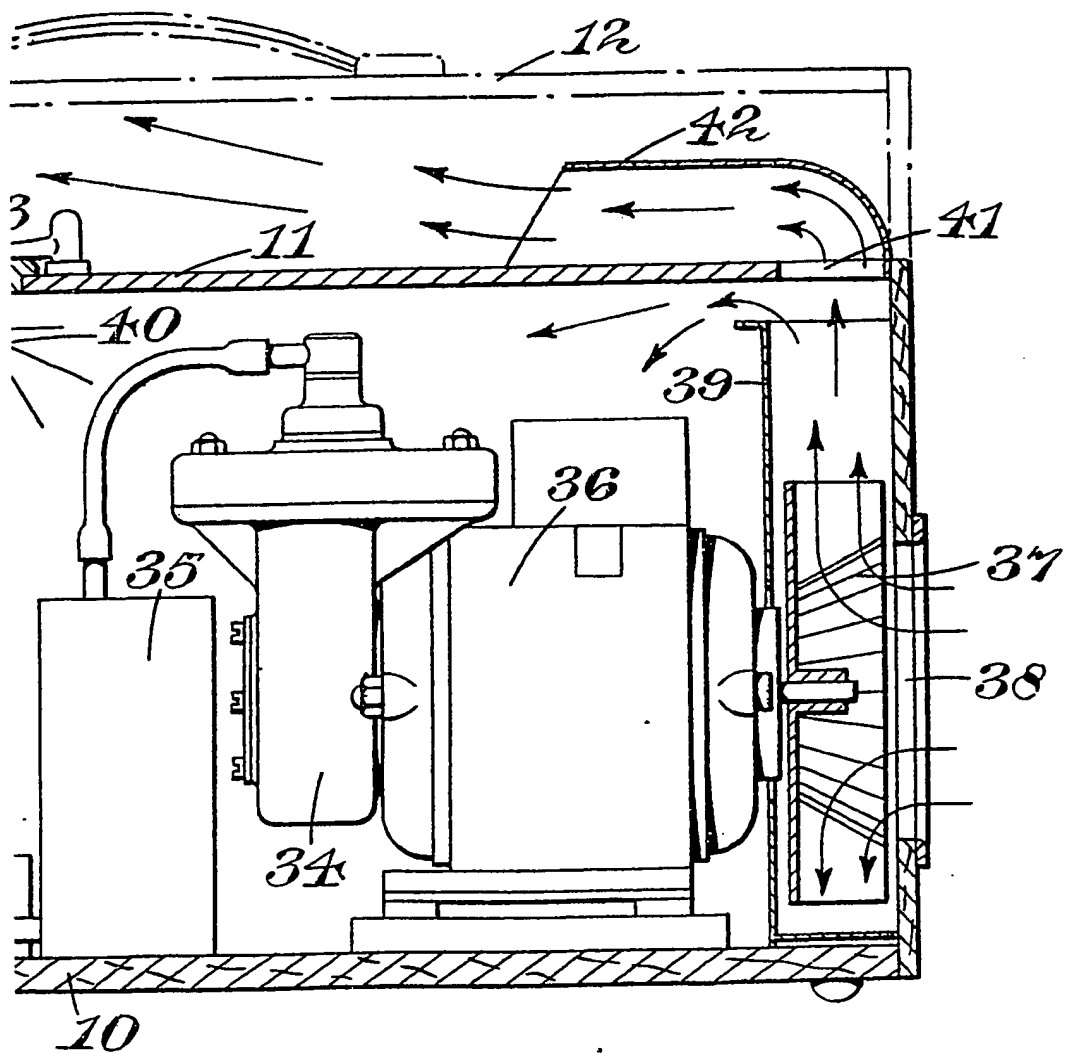
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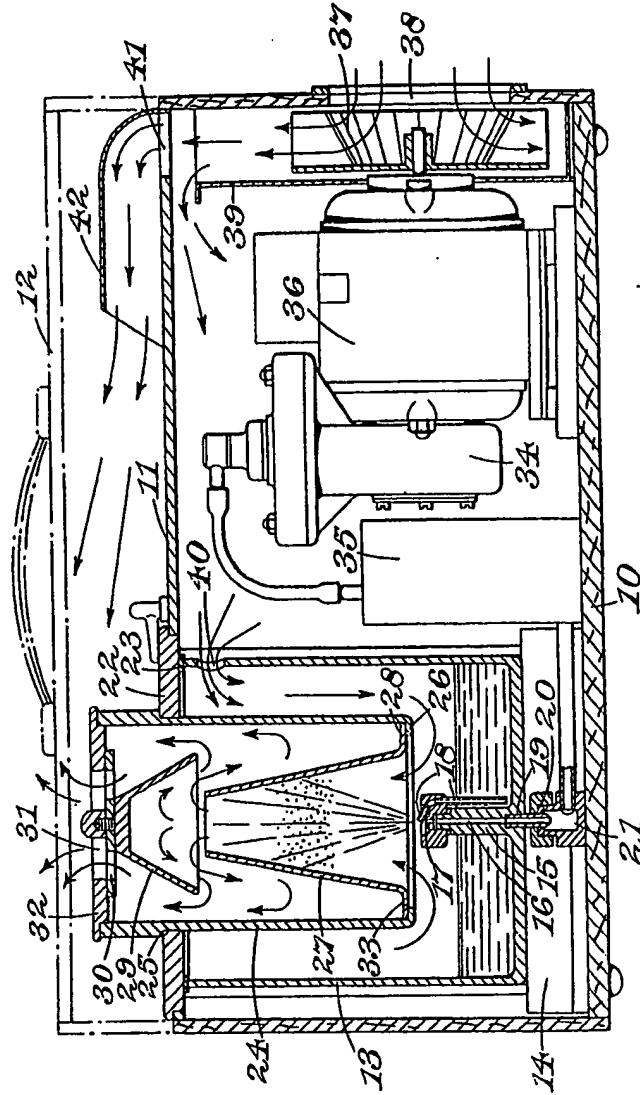
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1 SHEET



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DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
X	GB 525 736 A (PARR) * page 1, line 51 - line 59 * * page 4, line 6 - line 29; figure 1 * ----	1-9	B05B7/00 B05B7/08 B05B7/04
X	GB 2 055 307 A (BARD) 4 March 1981 (1981-03-04) * abstract; figures 2-4 * * page 6, line 84 - line 87 * ----	1-4,6,7	
X	US 3 744 722 A (BURNS) 10 July 1973 (1973-07-10) * column 4, line 41 - column 5, line 2; figures 1,2 * ----	1,2,4,5	
A	US 5 743 468 A (LAIDLER) 28 April 1998 (1998-04-28) * column 5, line 62 - column 7, line 40; figure 1 * ----	10	
A	US 5 480 095 A (STEVENSON ET AL.) 2 January 1996 (1996-01-02) * column 9, line 33 - column 10, line 67; figures 11-16 * ----	10	TECHNICAL FIELDS SEARCHED (Int.Cl.7)
X	US 4 545 535 A (KNAPP) 8 October 1985 (1985-10-08) * column 11, line 57 - column 12, line 8; figures 1,2,6,8,9 * ----	15-18	B05B
X	EP 0 655 282 A (AROMANUANCE) 31 May 1995 (1995-05-31) * abstract; figures 2,4,6C,,8 * ----	15,16	
X	WO 91 03270 A (VICTORIA UNIVERSITY OF MANCHESTER) 21 March 1991 (1991-03-21) * abstract; figure 3 * -----	15,16	
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 5 July 2000	Examiner Guastavino, L
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